

MARSHALL STAR

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NASA Begins Development of Space Launch System Flight Software

By *Sanda Martel*

NASA engineers working on the new Space Launch System, or SLS, can now begin developing the advanced, heavy-lift launch vehicle's flight software using newly delivered software test bed computers from Boeing.

Image right: Discussing the plan to fine-tune the SLS launch vehicle's flight software are, from left, Kurt Jackson, SLS integrated avionics and software discipline lead engineer and a manager of the Software Development Group; Ken King, Software Development team member; Bob Linner, Avionics and Software chief engineer in the SLS Program Office; and Paul Doyle, Software Development team member. An early delivery of the avionics hardware to the Marshall Center allows the SLS team -- both NASA and Boeing -- to accelerate flight software development. (NASA/MSFC/Emmett Given)



The SLS will launch NASA's Orion spacecraft and provide an entirely new capability for human exploration beyond Earth's orbit. Designed to be flexible for crew or cargo missions, SLS and Orion will be safe, affordable, sustainable and continue America's journey of discovery from the unique vantage point of space.

"We are moving out very quickly on SLS," said Todd May, Space Launch System program manager at the Marshall Space Flight Center. "SLS will be the most powerful launch vehicle ever built, and it requires the most capable flight software in the history of human spaceflight. Having this avionics hardware in place early will allow the NASA SLS team and Boeing to accelerate the flight software development."



The test bed computers make it possible for NASA to begin fine-tuning the launch vehicle's software. Markeeva Morgan, avionics hardware lead for the SLS Stages element office, and Walter Robinson, command and data handling hardware lead, data systems development team, worked closely with Boeing to ensure delivery and integration of the hardware. The software development team includes team lead Yvette Binford, supported by Ken King, design team co-lead, and Paul Doyle, a flight software engineer for Draper Laboratory in Huntsville.

Image left: Dan Mitchell, left, an SLS integrated avionics and software discipline lead engineer and a manager of the

Software Development group in Marshall's Engineering Directorate, and Walter Robinson, command and data handling hardware lead, Data Systems Development team, check out the SLS flight computer test beds which were recently delivered to Marshall by Boeing, the SLS Stages prime contractor, for a process to begin fine-tuning the launch vehicle software. (NASA/MSFC/Emmett Given)

Kurt Jackson and Dan Mitchell are the SLS integrated avionics and software discipline lead engineers and manage the software development group.

After the software avionics team completes its work, the SLS flight software will be installed in the Software Integration Test Facility at Marshall for testing with other electrical hardware and software, said Bob Linner, avionics and software chief engineer in the Space Launch System Program Office. In this facility, the SLS team can run a variety of mission profiles to evaluate how the vehicle performs in a real-time simulated environment.

The SLS flight computer has the highest processing capability available in a flight avionics computer. It is being developed by upgrading existing systems used in Global Positioning System and communication satellites.

Image right: Markeeva Morgan, left, avionics hardware lead for SLS Core Stage element office, and Walter Robinson, command and data handling hardware lead of the Data Systems Development Team, integrate the software test beds into the laboratory. SLS will be the most powerful launch vehicle ever built, and it requires the most capable flight software in the history of human spaceflight. Having this avionics hardware in place early allows the SLS team – both NASA and Boeing – to accelerate the flight software development. (NASA/MSFC/Emmett Given)



Triple modular redundant processors within each flight computer exchange data, interpret that data, and then each computer "votes" to ensure there is agreement. The three flight computers then compare those answers and send commands out to the vehicle for execution as appropriate. This configuration, with a complement of NASA-developed flight software, is called the Flight Computer Operational Group and controls the launch vehicle during preflight tanking operations and during flight.

The technology used to develop these flight computers is proven from years of satellite applications and is reliable enough to take SLS beyond Earth's orbit, Linner said.



(NASA/MSFC/Emmett Given)

The first test flight of the SLS is scheduled for 2017, for which the launch vehicle will be configured for a 70-metric-ton lift capacity. An evolved, two-stage launch vehicle configuration will provide a lift capability of 130 metric tons to enable missions beyond Earth's orbit and support deep space exploration.

Image left: Paul Doyle, right, Yvette Binford, center, and Ken King integrate and debug the SLS avionics software. After the Software Avionics team completes its work, the SLS flight software will be installed in Marshall's Software Integration Test Facility for testing with other electrical hardware and software. In that facility, the SLS team can run a variety of mission profiles to evaluate how the vehicle performs in a real-time simulated environment.

The SLS software test bed computers were developed by Boeing and delivered to Marshall ahead of schedule. Availability of this test bed platform early in the engineering development phase allows more time for NASA programmers to develop

the most capable flight software in the history of spaceflight.

For more information about SLS and images of the software test bed facility and team, visit <http://www.nasa.gov/sls>.

For more information about Orion, visit <http://www.nasa.gov/orion>.

Martel, an AI Signal Research Inc. employee, supports the Office of Strategic Analysis & Communications.

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SpaceX Dragon Capsule Returns to Earth after First Commercial Flight to Space Station

NASA news release

SpaceX's Dragon capsule splashed down in the Pacific Ocean at 10:42 a.m. CDT May 31 a few hundred miles west of Baja California, Mexico - marking a successful end to the first mission by a commercial company to resupply the International Space Station.

Image right: The SpaceX Dragon cargo vehicle floats in the Pacific Ocean after splashdown. (SpaceX)



"Congratulations to the teams at SpaceX and NASA who worked hard to make this first commercial mission to the International Space Station an overwhelming success," NASA Administrator Charles Bolden said. "This successful splashdown and the many other achievements of this mission herald a new era in U.S. commercial spaceflight. American innovation and inspiration have once again shown their great strength in the design and operation of a new generation of vehicles to carry cargo to our laboratory in space. Now more than ever we're counting on the inventiveness of American companies and American workers to make the International Space Station and other low-Earth orbit destinations accessible to any and all who have dreams of space travel."

The Dragon capsule will be taken by boat to a port near Los Angeles, where it will be prepared for a return journey to SpaceX's test facility in McGregor, Texas, for processing. Some cargo will be removed at the port in California and returned to NASA within 48 hours. The remainder will be returned to Texas with the capsule.

The capsule delivered to the station 1,014 pounds of supplies including experiments, food, clothing and technology. On its return trip to Earth, the capsule carried science experiments that will be returned to researchers hoping to gain new insights provided by the unique microgravity environment in the station's laboratories. In addition to the experiments, Dragon returned a total of 1,367 pounds of hardware and cargo no longer needed aboard the station.

Dragon's journey to the space station was SpaceX's second demonstration mission under NASA's Commercial Orbital Transportation Services (COTS) Program, which provides investments to stimulate the commercial space industry in America. The mission began May 22 as the capsule launched from Cape Canaveral Air Force Station in Florida aboard a SpaceX Falcon 9 rocket. Following a series of tests of its maneuverability and abort systems, the capsule was grappled and berthed to the space station by the crew members of Expedition 31 aboard the orbiting complex.

In the next several weeks, NASA will evaluate the Dragon capsule's mission performance to close out remaining COTS

milestones. Once that work is completed NASA and SpaceX will set the target date for the company's first full cargo mission.

In addition to fostering the development of new American cargo vehicles, NASA also is helping spur innovation and development of new spacecraft and launch vehicles from the commercial industry to develop safe, reliable and cost-effective capabilities to transport astronauts to low-Earth orbit and the space station.

NASA also is developing the Orion spacecraft and Space Launch System, or SLS, a crew capsule and heavy-lift rocket that will provide an entirely new capability for human exploration beyond low-Earth orbit. Designed to be flexible for launching spacecraft for crew and cargo missions, SLS and Orion will expand human presence beyond low-Earth orbit and enable new missions of exploration across the solar system.

For SpaceX mission information and a schedule of NASA TV coverage, visit: <http://www.nasa.gov/spacex>.

For more information about the International Space Station, visit: <http://www.nasa.gov/station>.

For more information about NASA's commercial space programs, visit: <http://www.nasa.gov/exploration/commercial>.

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Games, Food, Music and Fun at MSFC Family Picnic



Most of the 150 summer student interns at the Marshall Space Flight Center were among the volunteers at the MSFC Family Picnic June 2, hosted by the Marshall Exchange. More than 2,000 Marshall team members, retirees and their families came out to the event, held around the walking trail -- across from the Marshall Child Development Center -- and Buildings 4315 and 4316. (NASA/MSFC/Fred Deaton)

More than a dozen classic and exotic vehicles and motorcycles -- owned and maintained by Marshall team members and their guests -- were on display at the picnic's car, truck and bike show. Raymond Bradley, team lead in Marshall's Property Management Office, won the \$150 first-place prize for his blue 1971 Chevelle 350. Robert Butler, an IT specialist in Marshall's Communication Services Office, was a double winner. He took home the \$100 second-place prize for his 1969 Mustang Mach 1 Cobrajet, and the \$50 third-place reward for his 1969 Firebird H.O. The winning vehicles were chosen by picnic attendees. (NASA/MSFC/Rich Wegrich)



Stephen Doering, director of Marshall's Office of Center Operations, goes down with a splash at the dunking booth. The dunking booth was just one of a host of games and activities at the picnic, including water slides and inflatables. (NASA/MSFC/Fred Deaton)

A group of excited children -- and a few adults, too -- gather around for a little meet-and-greet with picnic newcomer Oscar the Robot. (NASA/MSFC/Fred Deaton)





B-I-N-G-O! Players raise their hands to get in on the next round of bingo, one of the most popular activities at the picnic. Several lucky winners went home with iPads, flat-screen televisions, portable generators and other great prizes. (NASA/MSFC/Fred Deaton)

The music group Nuthin Fancy, which includes Marshall team members Pete Allen and Louie Clayton, perform classic rock tunes at the picnic. (NASA/MSFC/Fred Deaton)



Children make their way through one of the picnic's many inflatables. For more pictures from the MSFC Family Picnic, team members can visit the event gallery [here](#). (NASA/MSFC/Fred Deaton)

UAHuntsville Among Five Universities Selected for NASA X-Hab Innovation Challenge

NASA news release

The University of Alabama in Huntsville is among five universities that have been selected to participate in the 2013 Exploration Habitat (X-Hab) Academic Innovation Challenge led by NASA and the National Space Grant Foundation. These universities will design habitat systems, concepts and technologies that could be used in future deep space habitats.

The selection is the first milestone in a year-long process for these five teams. Throughout the 2012-2013 academic year, the teams will meet a series of milestones to design, manufacture, assemble and test their systems and concepts in cooperation with the NASA Advanced Exploration Systems (AES) Program's Habitation Systems Project team.

"The X-Hab Academic Innovation Challenge is an exciting opportunity to engage university teams in the design process for NASA's next generation space systems," said Jason Crusan, NASA's AES Program manager at NASA Headquarters. "The agency benefits from the fresh and innovative perspective of these university teams, and they learn about deep space human exploration and the systems engineering approach from an experienced NASA team."

The challenge is a university-level participatory exploration effort designed to encourage studies in spaceflight-related disciplines. The challenge encourages multidisciplinary approaches, further outreach efforts and partnering with experts and industry. This design challenge requires undergraduate students to explore NASA's work on development of deep space habitats while also helping the agency gather new ideas to complement its current research and development.

NASA selected these five teams from among a group of proposals received in May.

The X-Hab Academic Innovation Challenge 2013 teams are:

- California State Polytechnic University: Vertical Habitability Layout and Fabrication Studies
- Oklahoma State University: Deep Space Habitat, Horizontal Habitability Layout Studies
- Texas A&M University: Wireless Smart Plug for DC Power
- University of Alabama in Huntsville: Design and Development of a Microgravity Random Access Stowage and Rack System
- University of Colorado at Boulder: Remote Plant Food Production Capability

The National Space Grant Foundation will fund design costs, development and delivery of the systems to the AES Habitat Systems team during the summer of 2013.

NASA's Human Exploration and Operations Mission Directorate's Advanced Exploration Systems Program, via the Habitat Systems Project team, is sponsoring the technology challenge. NASA is dedicated to supporting research that enables sustained and affordable human and robotic exploration. This educational challenge contributes to the agency's efforts to train and develop a highly skilled scientific, engineering and technical workforce for the future.

For information about competition registration and requirements, visit <http://www.spacegrant.org/xhab>.

For more information about the Advanced Exploration System Program Habitation Systems Project team, visit <http://go.nasa.gov/L37Ymq>.

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A Supernova Cocoon Breakthrough

Observations with NASA's Chandra X-ray Observatory have provided the first X-ray evidence of a supernova shock wave breaking through a cocoon of gas surrounding the star that exploded. This discovery may help astronomers understand why some supernovas are much more powerful than others.

On Nov. 3, 2010, a supernova was discovered in the galaxy UGC 5189A, located about 160 million light years away. Using data from the All Sky Automated Survey telescope in Hawaii taken earlier, astronomers determined this supernova exploded in early October 2010 (in Earth's timeframe).

This composite image of UGC 5189A shows X-ray data from Chandra in purple and optical data from Hubble Space Telescope in red, green and blue. SN 2010jl is the very bright X-ray source near the top of the galaxy.

A team of researchers used Chandra to observe this supernova in December 2010 and again in October 2011. The supernova was one of the most luminous that has ever been detected in X-rays.



In optical light, SN 2010jl was about 10 times more luminous than a typical supernova resulting from the collapse of a massive star, adding to the class of very luminous supernovas that have been discovered recently with optical surveys. Different explanations have been proposed to explain these energetic supernovas including the interaction of the supernova's blast wave with a dense shell of matter around the pre-supernova star; radioactivity resulting from a pair-instability supernova, triggered by the conversion of gamma rays into particle and anti-particle pairs; and emission powered by a neutron star with an unusually powerful magnetic field.

In the first Chandra observation of SN 2010jl, the X-rays from the explosion's blast wave were strongly absorbed by a cocoon of dense gas around the supernova. This cocoon was formed by gas blown away from the massive star before it exploded.

In the second observation taken almost a year later, there is much less absorption of X-ray emission, indicating that the blast wave from the explosion has broken out of the surrounding cocoon. The Chandra data show that the gas emitting the X-rays has a very high temperature -- greater than 100 million degrees Kelvin -- strong evidence that it has been heated by the supernova blast wave.

The energy distribution, or spectrum, of SN 2010jl in optical light reveals features that the researchers think are explained by the following scenario: Matter around the supernova has been heated and ionized (electrons stripped from atoms) by X-rays generated when the blast wave plows through this material. While this type of interaction has been proposed before, the new observations directly show, for the first time, that this is happening.

This discovery therefore supports the idea that some of the unusually luminous supernovas are caused by the blast wave from their explosion ramming into the material around it.

In a rare example of a cosmic coincidence, analysis of the X-rays from the supernova shows that there is a second unrelated source at almost the same location as the supernova. These two sources strongly overlap one another as seen on the sky. This second source is likely to be an ultraluminous X-ray source, possibly containing an unusually heavy stellar-mass black hole, or an intermediate mass black hole.

These results were published in a paper appearing in the May 1, 2012, issue of The Astrophysical Journal Letters. The authors were Poonam Chandra of the Royal Military College of Canada, Kingston, Canada; Roger Chevalier and Christopher Irwin of the University of Virginia in Charlottesville; Nikolai Chugai of the Institute of Astronomy of Russian Academy of Sciences in Moscow, Russia; Claes Fransson of Stockholm University in Sweden; and Alicia Soderberg of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass. (X-ray: NASA/CXC/Royal Military College of Canada/P.Chandra et al; Optical: NASA/STScI)

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Marshall's Dr. Gerald Fishman Speaks About High-Energy Astronomy at UAHuntsville



Dr. Gerald Fishman, an astrophysicist in the Marshall Space Flight Center's Science & Technology Office, greets guests May 30 after his presentation at the University of Alabama in Huntsville's Chan Auditorium. Fishman presented an overview of the history of high-energy astronomy as part of UAH's Distinguished Lecture Series. High-energy astronomy is the study of the most energetic objects and regions of the universe. Fishman emphasized research performed by scientists in Huntsville. Fishman was the principal investigator for the Burst and Transient Source Experiment, or BATSE. It is an extremely sensitive gamma-ray burst detector which flew on NASA's Compton Gamma Ray Observatory from 1991-2000. He currently is a coinvestigator on the Gamma-ray Burst Monitor, a key instrument aboard the Fermi Gamma-ray Space Telescope. It launched in

2008 and is still in operation. Its primary objective is also the study of gamma-ray bursts that appear randomly in the sky at a rate of about 300 per year. Gamma-ray bursts are the brightest, most explosive events known to occur in the universe. In 2011, Fishman received the Shaw Prize in Astronomy and was recognized for his leadership in research that shed new light on gamma-ray bursts. (NASA/MSFC/Janet Anderson)

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Marshall team to celebrate 'Take Our Children to Work Day' June 7

Engineers, scientists and support teams at the Marshall Space Flight Center will show the next generation how it's done June 7 during Marshall's annual "Take Our Children to Work Day" event.

Marshall civil service and contract employees' children in grades 3-12 will participate in activities and learning sessions tied

to a variety of work conducted by Marshall Center teams -- from testing of next-generation flight hardware to study of advanced scientific principles that inform cutting-edge NASA research. Additional sessions will focus on water safety, preventing bullying, fiscal responsibility and careers in science, engineering and aerospace.

The event will open at 8:15 a.m. in Morris Auditorium in Building 4200, where acting Marshall Center Director Gene Goldman will welcome participants and outline the day's planned activities.

The "Take Our Children to Work Day" program, organized by Marshall's Office of Diversity & Equal Opportunity, is designed to celebrate the work of the nation's space program and to demonstrate the value and rewards of studying science, engineering, math and technology.

Marshall organizations and teams across the center will take part in educational sessions. Additional sponsors include the U.S. Space & Rocket Center, Redstone Federal Credit Union, Sci-Quest, Huntsville Utilities, Dynetics Corp., the North Alabama Coast Guard Auxiliary and WHNT-TV, all of Huntsville.

For more information, visit <http://eo.msfc.nasa.gov/c2w/>.

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<http://www.nasa.gov/centers/marshall/about/star/index.html>